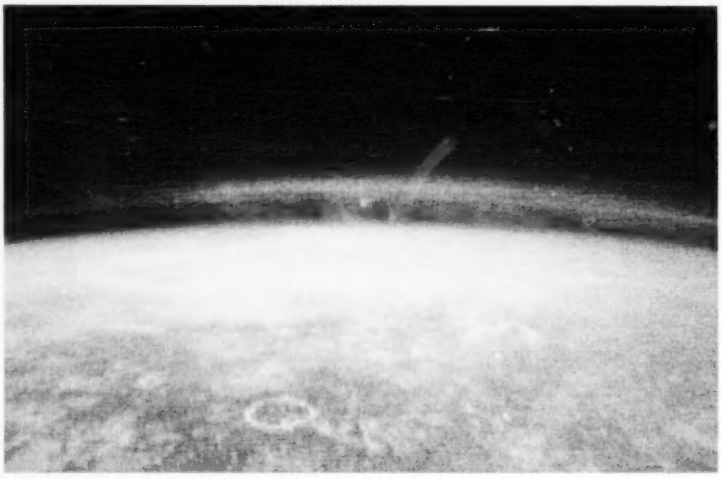
Column 433

Light storms rage above the sky

by Claire Eamer

Think of the aurora -- the northern lights -- as a giant television picture of Earth's magnetic weather.

That's roughly how California-based physicist Christopher Russell explained it during a recent videoconference on a new research project named THEMIS.



A photograph taken from the International Space Station in January 2003 shows the aurora above northern Quebec, with the Manicouagan impact crater visible below.

(photo: NASA)

Pulses of energy called the solar wind blow outward from the sun, interacting with Earth's magnetic field, or magnetosphere. Some of the energy is released in bursts of charged particles that show up as coloured lights on the screen of the upper atmosphere.

When the lights change colour and dance around the sky, as they often do, watchers on the ground are seeing a giant picture of a substorm, a kind of energy storm, in the aurora.

THEMIS, mercifully short for Time History of Events and Macroscale Interactions during Substorms, will use a combination of satellites and ground-based observatories to determine where auroral substorms start and how they develop.

Sixteen of the 20 ground-based observatories will be located in Canada, including one just outside Whitehorse.

Auroral substorms are familiar to anyone living within good viewing range of the northern lights. An unspectacular display will suddenly erupt, with flares and swirls of coloured light moving across the sky. The substorm that creates a spectacular light show can also disrupt radio transmissions, throw satellites into an electronic tizzy, and occasionally knock out power systems on Earth.

To learn how substorms happen, the THEMIS project will launch five satellites in the fall of 2006. They will settle into orbits that line them up every four days on the dark

side of the planet where the solar wind pushes Earth's magnetosphere into a windsock shape.

By measuring energy changes at different locations within that windsock, the researchers hope to determine where the substorm events occur and in what order.

At the same time, the ground-based observatories will take photographs of the night sky every three seconds. The idea is to track, very precisely, the onset and progress of the substorm and match it with the energy readings from the satellites.

Eric Donovan of the University of Calgary is in charge of the 16 ground-based observatories in Canada. He says the ground systems are a vital part of the project.

"You could get it from space alone if you also imaged the aurora from space," he says. "That would take additional satellites -- and that is expensive, when we think we can do this well from the ground."

Each of the ground-based observatories will have an automated camera with a fish-eye lens that points straight up and can take an image of the entire sky, a magnetometer to measure fluctuations in Earth's magnetic field, and computerized systems to record and store the information.

An auroral substorm creates a spectacular display of northern lights above Atlin, B.C.

(photo: Tim Kinvig)

Donovan has been testing the systems and scouting locations for some time. It's not easy to find the perfect site, he says.

"We have to have sites that are optically dark, but we also need power to run the equipment and keep it warm, so we have to make some compromises."

Some of the compromises have been ingenious. At Prince George, the camera is installed on a 15-metre tower to get it above the trees. Another site is the Ekati diamond mine in the Northwest Territories, which offers power but not too much light.

Donovan and his group have been testing their systems in Athabasca, Alberta, but they're hoping to get several more observatories running this winter. With so many remote locations, they want to be sure everything works -- like the system for keeping frost and snow from obscuring the camera's view.

"We simply heat the enclosure the camera is in a little bit. That evaporates the snow and ice off the dome -- in principle," says Donovan. "We'll see how that works and

adjust our strategy if necessary."

While much of the information collected at the ground-based observatories will be stored for later analysis, some photographs will be transmitted by satellite directly to the research team, for scientific use and for display in real time on the Internet.

Public information is an important component of THEMIS, Donovan says. Besides, he adds, "the average Canadian is interested in the aurora, the northern lights."

For more information about the THEMIS project, go to http://ds9.ssl.berkeley.edu/themis.

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